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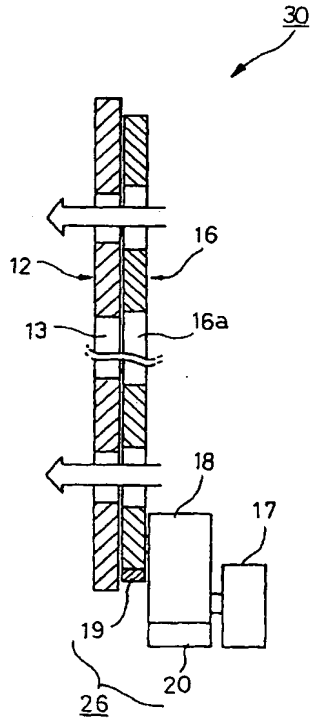
(54) Refrigerator

(57) A refrigerator has shutter device (30) for preventing the flow of air between an evaporator and a fresh food compartment. The shutter device (30) has a shutter member (16) for closing a cooling air flow path into a cooling compartment during defrosting or when the cooling compartment door is open.

FIG. 3



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Description

The present invention relates to a refrigerator comprising a cooling compartment, a cooling compartment door, an evaporator, a heater for defrosting the evaporator and a cooling air flow path between the evaporator and the cooling compartment.

In general, as shown in Figure 1, a refrigerator has a compressor 14 for compressing refrigerant, an evaporator 7 for generating cool air by evaporating the refrigerant supplied from the compressor 14, and a fan 10 for blowing the cool air generated by the evaporator 7. A duct member 12 forming a cool air duct is installed at the back of a fresh food compartment 3. The duct member 12 has a plurality of cool air discharge ports 13 opening into the fresh food compartment 3. Cool air blown by the fan 10 flows into the cool air duct, and is then supplied to the fresh food compartment 3 through the cool air discharge ports 13.

The fresh food compartment 3 has a door 2, and the fresh food compartment 3 is partitioned into a plurality of spaces by shelves 4. At the upper part of the fresh food compartment 3, a cover 5 for shielding the evaporator 7 is installed. The evaporator 7 is fixed by a holder 8 in a space 6 formed by the cover 5.

While the refrigerator is operating, frost forms on the evaporator 7. The cooling efficiency of the evaporator 7 is lowered by the frost. Consequently, the refrigerator is equipped with a heater 9 for removing the frost, and defrosts the evaporator 7 by heating the evaporator 7 using the heater 9 when the refrigerator is has been operating for a predetermined period of time.

In such a conventional refrigerator, there is a problem in that the heat generated by the heater 9 during defrosting is transmitted into the fresh food compartment 3. The heat generated by the heater 9 is mainly transmitted through the cooling air supply path. That is, the heat is mainly transmitted to the fresh food compartment 3 through the cool air duct and the cool air discharge ports 13. The cooling efficiency of the fresh food compartment 3 is lowered due to the heat transmitted to the fresh food compartment 3, and the freshness of the food stored therein cannot be maintained properly.

Furthermore, there is a problem in that the cool air generated by the evaporator 7 is continuously supplied into the fresh food compartment 3 even when the door 2 is open, so the supplied cool air flows out of the refrigerator, which is a loss of the cool air. Also, warm ambient air flows toward the evaporator 7 increasing the rate of generation of frost on the evaporator 7. Consequently, the defrosting must be performed more frequently. In order to perform the defrosting operation, the heater 9 radiates heat further reducing the cooling efficiency.

A refrigerator according to the present invention is characterised by blocking means for blocking the cooling air flow path during operation of the heater for defrosting the evaporator.

Preferably, the air flow path extends through an opening into the cooling compartment and the blocking means comprises a shutter means moveable between a first position in which the opening is unblocked and a second position in which the opening is blocked. More preferably, temperature sensing means for sensing the temperature of the evaporator and control means is included and the control means is responsive to the temperature sensing means to delay unblocking of the air flow path after operation of the heater for defrosting the evaporator. Still more preferably, the delay is sufficient for the temperature of the evaporator to fall to a level at which unblocking the opening will not significantly adversely affect the temperature in the cooling compartment.

Preferably, door open sensing means is included and the blocking means is response to the door open sensing means indicating that the door is open to block the air flow path.

Preferably, the blocking means comprises a motor and a cam for reciprocally driving the shutter means. More preferably, a reed switch and a magnet on the shutter means are arranged for detecting when the shutter means is in said second position.

An embodiment of the present invention will now be described, by way of example, with reference to Figures 2, 3 and 4 of the accompanying drawings, in which:-

Figure 1 is a partial cutaway perspective view of a prior art refrigerator;
Figure 2 is a block diagram of a refrigerator according to the present invention; and
Figures 3 and 4 are enlarged side sectional views of a shutting device for a refrigerator for preventing transmission of heat according to the present invention.

In the following description, parts common to the refrigerator according to the present invention and the above-described prior art refrigerator will not be described in detail again. However, the same reference signs are employed.

Referring to Figure 2, a refrigerator according to the present invention has a temperature sensing part 22 for sensing the temperature in the fresh food compartment 3, a door open/close sensing part 23 for sensing opening and closing of the door 2, a microcomputer 21 for controlling the overall operation of the refrigerator, a compressor driving part 24 for driving the compressor 14, a fan driving part 25 for driving fan 10, a heater driving part 28 for driving the heater 9, a shutter sensing part 26 and a shutter driving part 27 for driving a shutter device 30 which will be described later.

The temperature sensing part 22 comprises a plurality of temperature sensors (not shown) installed in the fresh food compartment 3. The door open/close sensing part 23 is comprises a push button switch (not shown) installed at the front of the fresh food compartment 3 and which is pushed when the door 2 is closed and re-

leased when the door 2 is opened. The signals from the temperature sensing part 22, the door open/close sensing part 23, and the shutter sensing part 26 are input into the microcomputer 21, and the microcomputer 21 controls the compressor driving part 24, the fan driving part 25, and the shutter driving part 27 on the basis of the input signals.

Referring to Figures 3 and 4, the shutter device 30 comprises of a shutter member 16 disposed closely to the duct member 12 for opening and closing the cool air discharge ports 13, a motor 17 driven by the shutter driving part 27 for driving the shutter member 16, and a power transmission 18 for transmitting power from the motor 17.

The shutter member 16 has a plurality of air holes 16a. According to the position of the shutter member 16, the cool air discharge ports 13 of the duct member 12 are open as shown in Figure 3, or closed as shown in Figure 4.

The power transmission 18 comprises a cam and gears which convert rotational movement of the motor 17 into up-and-down movement of the shutting member 16.

The shutter sensing part 26 (shown in Figure 2) comprises a reed switch 20 and a magnet 19 for driving the reed switch 20. The reed switch 20 is installed at the bottom of the power transmission 18, and the magnet 19 is installed at the bottom of the shutter member 16. When the shutter member 16 is moved down by the operation of the motor 17, the cool air discharge ports 13 are closed as shown in Figure 4 and the reed switch 20 is closed by the magnet 19. Then, the microcomputer 21 senses the completion of the closing operation of the shutting member 16, and stops operating the motor 17.

The fan driving part 25 and the heater driving part 27 are controlled by the microcomputer 21, and drive the fan 10 and the heater 9 respectively.

The operation of the above-describe refrigerator will now be described.

The microcomputer 21 controls the compressor driving part 24 and the fan driving part 25 on the basis of the signals from the temperature sensing part 22. In other words, when the temperature in the fresh food compartment is higher than a temperature set by a user, the microcomputer 21 operates the compressor 14 and the fan 10, and the evaporator 7 generates cool air which is then supplied to the fresh food compartment 3 by the fan 10.

The microcomputer 21 calculates the duration of cooling by the refrigerator. That is, the time during which cool air is generated by the evaporator 7 by the operation of the compressor 14 is calculated. When the calculated duration reaches a predetermined period, the microcomputer 21 controls the compressor driving part 24 and the fan driving part 25 so that the compressor 14 and the fan 10 stop operating, and then performs defrosting of the evaporator 7. First, the microcomputer 21 drives the driving motor 17 so that the cool air discharging ports 13 are closed by the shutter member 16 as shown in Figure 4. Then the microcomputer 21 controls the heater driving part 28 to operate the heater 9. The frost generated on the evaporator 7 is removed by the heat of the heater 9.

After performing defrosting for some time, the microcomputer 21 de-energises the heater 9. The microcomputer 21 maintains the cool air discharge ports 13 closed for a predetermined time after the operation of the heater 9 is stopped.

Once the operations of the compressor 14 and the heater 9 have been stopped for a period, the microcomputer 21 operates the compressor 14 again for generating the cool air. When the operation of the evaporator 7 for generating the cool air has continued for a predetermined time, the microcomputer 21 drives the motor 17 so that the cool air discharge ports 13 are opened by the shutter member 16 as shown in Figure 3. In this situation, the predetermined time is the time that is sufficient for the temperature of the evaporator 7 to be lowered below the temperature of the fresh food compartment 3. Since the flow of the heat generated by the heater 9 during the defrosting operation into the fresh food compartment 3 is prevented by the shutter device 30, the temperature of the fresh food compartment 3 is maintained properly, and in particular, since the cool air discharge ports 13 are opened after the temperature of the evaporator 7 is sufficiently lowered, the temperature of the fresh food compartment 3 is efficiently preserved.

While the refrigerator is operating, when the opening of the door 2 is sensed by the door open/close sensing part 23, the microcomputer 21 controls the fan driving part 25 to stop operating the fan 10 and controls the shutter driving part 27 to shut off the cool air discharge ports 13. In other words, the microcomputer 21 stops operating the fan 10 through the fan driving part 25, and drives the driving motor 17 through the shutter driving part 27. Then, the shutter member 16 is moved down and the cool air discharge ports 13 are shut off by the shutter member 16 as shown in Figure 4. The shutter sensing part 26 senses the closing of the cool air discharge ports 13, and then the microcomputer 21 controls the shutter driving part 27 to stop operating the motor 17. When the door open/close sensing part 23 senses that the door 2 is open, the microcomputer 21 keeps the cool air discharge ports 13 closed.

According to such a processes, the space, in which the evaporator 7 is installed, is isolated from the fresh food compartment 3 when the door 2 is open. Therefore, the supply of cool air into the fresh food compartment is stopped, and thereby the loss of the cool air caused by the leakage of the cool air is prevented. Furthermore, the warm ambient air flowing into the fresh food compartment 3 does not flow toward the evaporator 7. Therefore, frost build up on the evaporator 7 is prevented and the cooling efficiency of the evaporator 7 is enhanced and frequent defrosting is not required.

When closing of the door 2 is sensed by the door

open/close sensing part 23, the microcomputer 21 controls the shutter driving part 27 to open the cool air discharge ports 13 as shown in Figure 3, and controls the fan driving part 25 to resume the operation of the fan 10. The microcomputer 21 controls again the compressor driving part 24 and the fan driving part 25 on the basis of the temperature sensed by the temperature sensing part 22. Then, normal operation by the refrigerator is resumed.

Claims

1. A refrigerator comprising a cooling compartment, a cooling compartment door, an evaporator, a heater for defrosting the evaporator and a cooling air flow path between the evaporator and the cooling compartment, **characterised** by blocking means (16, 17, 18, 21, 26, 27, 28) for blocking the cooling air flow path during operation of the heater for defrosting the evaporator.

2. A refrigerator according to claim 1, wherein the air flow path extends through an opening (13) into the cooling compartment and the blocking means comprises a shutter means (16) moveable between a first position in which the opening (13) is unblocked and a second position in which the opening (13) is blocked.

3. A refrigerator according to claim 1 or 2, including temperature sensing means (22) for sensing the temperature of the evaporator and control means (21), wherein the control means (21) is responsive to the temperature sensing means (22) to delay unblocking of the air flow path after operation of the heater for defrosting the evaporator.

4. A refrigerator according to claim 3, wherein said delay is sufficient for the temperature of the evaporator to fall to a level at which unblocking the opening will not significantly adversely affect the temperature in the cooling compartment.

5. A refrigerator according to any preceding claim, including door open sensing means (23), wherein the blocking means is response to the door open sensing means (23) indicating that the door is open to block the air flow path.

6. A refrigerator according to claim 2, wherein the blocking means comprises a motor (17) and a cam (18) for reciprocally driving the shutter means (16).

7. A refrigerator according to claim 6, including a reed switch (20) and a magnet (19) on the shutter means (16) arranged for detecting when the shutter means (16) is in said second position.

8. A refrigerator comprising:

a body forming a cooling compartment;
an evaporator for generating cool air to be supplied into a cooling compartment by evaporating refrigerant;
a heater for defrosting said evaporator;
a door for opening/closing said cooling compartment;
a means for sensing opening and closing of said door; and
a device for shutting a space that said evaporator is installed against said cooling compartment during a defrosting operation of said heater and/or when an opening of said door is sensed by said sensing means.

9. The refrigerator as claimed in claim 8, wherein said shutting device comprises:

a shutting member being formed with a plurality of air holes corresponding to a plurality of cool air discharge ports opened in said cooling compartment;
a motor for driving said shutting member; and
a control part for controlling said motor to open/close the cool air discharge ports with said shutting member.

10. The refrigerator as claimed in claim 9, further comprising a fan for blowing the cool air generated by said evaporator into said cooling compartment; wherein said control part controls said fan so that operation of said fan is stopped when said door is open.

11. The refrigerator as claimed in claim 8, wherein said shutting device releases a shutting state when a temperature of said evaporator falls down below a predetermined temperature after the defrosting operation of said heater ends.

FIG. 1

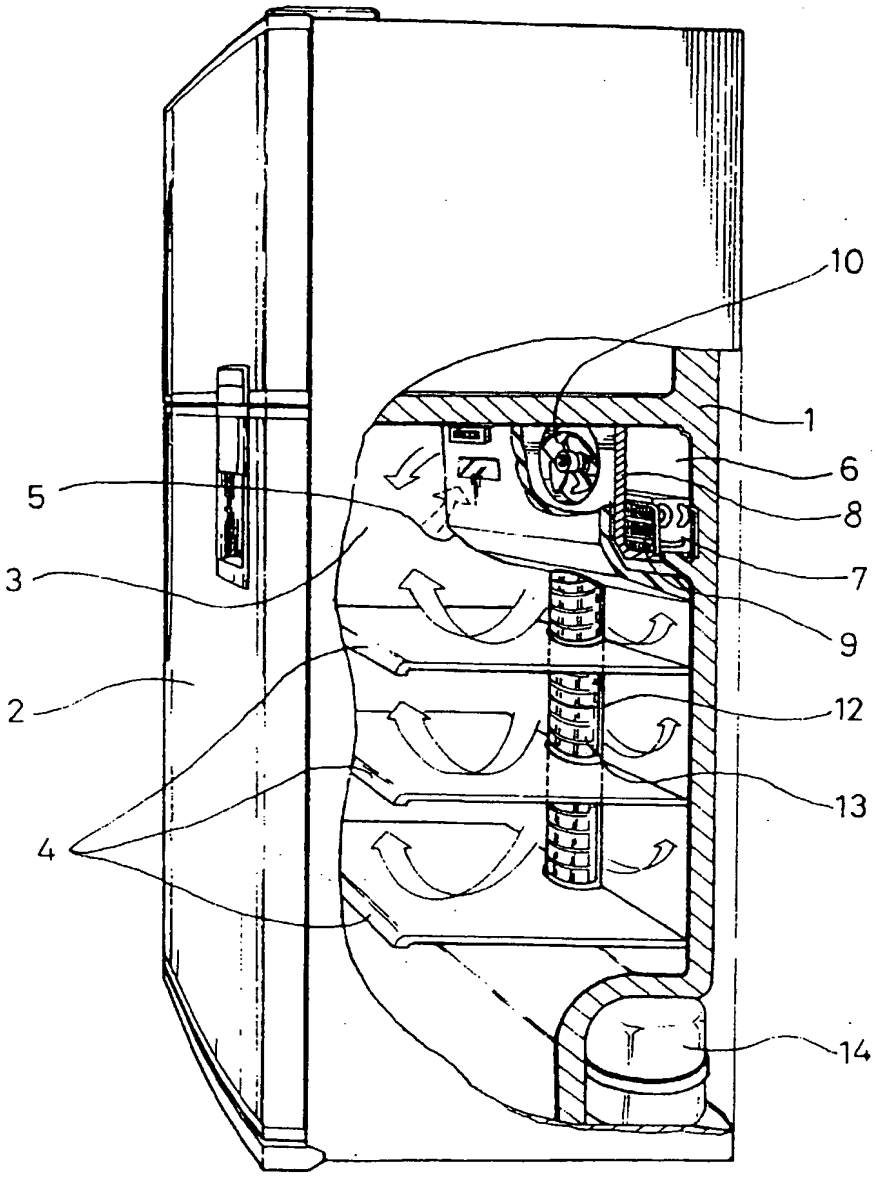

FIG. 2

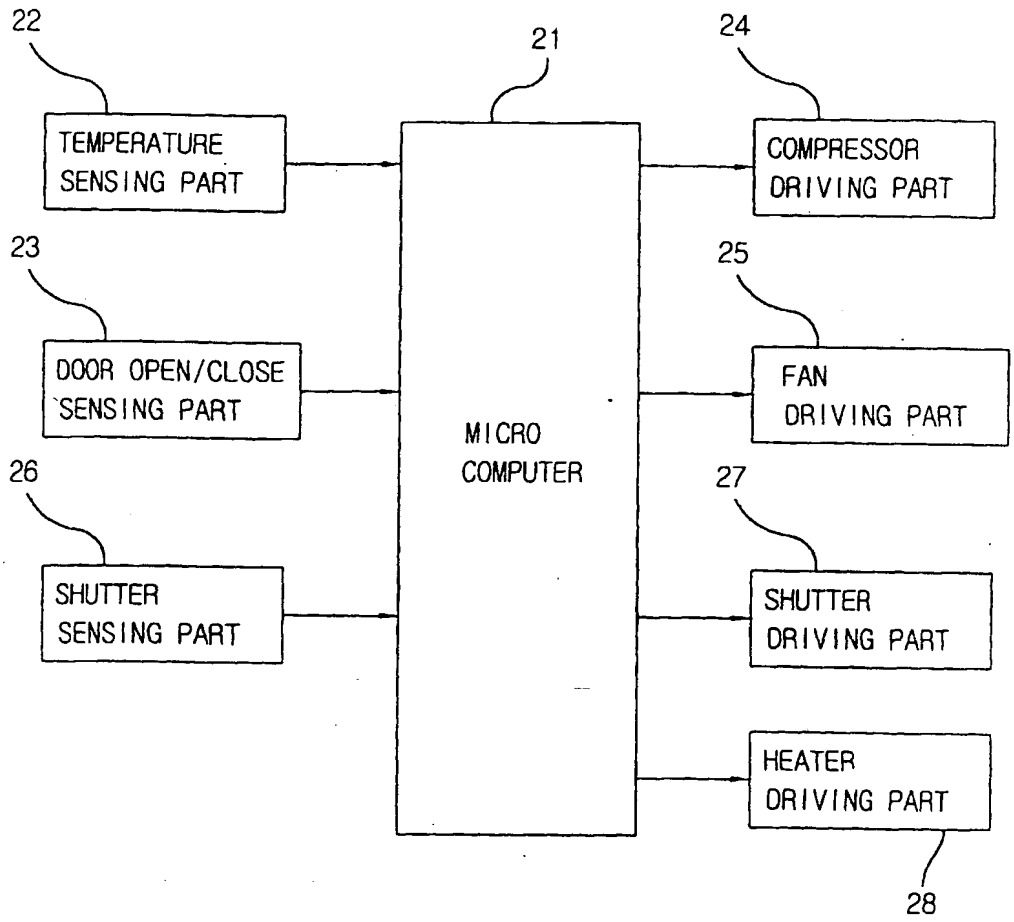
22
TEMPERATURE SENSING PART
23
DOOR OPEN/CLOSE SENSING PART
26
SHUTTER SENSING PART
21
MICRO COMPUTER
24
COMPRESSOR DRIVING PART
25
FAN DRIVING PART
27
SHUTTER DRIVING PART
HEATER DRIVING PART
28

FIG. 3

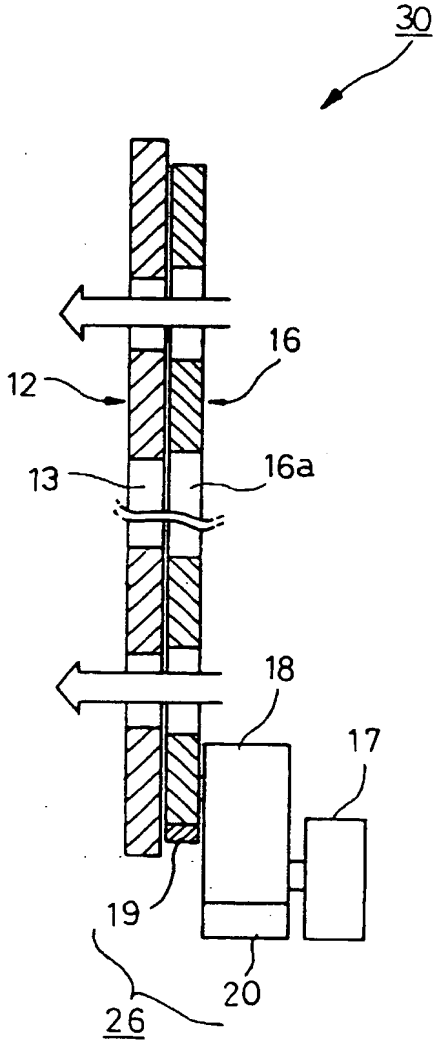

FIG. 4